The Role of Laccase in Peatland Carbon Cycling: Method and Mechanism

XIANG Wu*, ZHAO Yunpeng and HUANG Yubing

Hubei Key Laboratory of Critical Zone Evolution, School of Earth Sciences, China University of Geosciences, Wuhan 430074, China

Abstract: The large reservoir of organic carbon in peatland is essential for the global carbon cycle. Laccase, probably the largest class of phenol oxidases in soil, plays a key role in the primary degradation of recalcitrant polyphenolics such as lignin. However, the traditional method used to test laccase activity may not be suitable for peatland. We found ferrous iron in peatland can significantly affect the measurement of laccase activity by delaying the ABTS⁺ absorbance dynamic inflection point. Through the multi-factor interference test, we proposed a novel method based on delay dynamics (MDD) to determine laccase activity in peatland and applied it to the investigation of Dajiuhu peatland. The results show that the laccase activities measured using MDD (24.45±10.89 μmol·g⁻¹·h⁻¹) are considerably higher than that measured by the traditional method (12.10±12.06 μmol·g⁻¹·h⁻¹). In addition, our investigation indicated Fe-bound OC contents varied regularly with the succession gradients characterized as different vegetation. Microbial community analysis results show the potential impact of fungi as well as laccase on the accumulation of Fe-bound OC appears to be greater than that of bacteria in peatland. Furthermore, the simulation results confirmed laccase was capable of promoting the formation of Fe-OM association, which showed that DOC coprecipitating into an Fe-OM association was dramatically increased from 3.3%, 6.35% and 8.21% without laccase to 10.16%, 19.37% and 21.53% in the presence of laccase at an initial Fe/C molar ratio of 0.1, 0.25 and 0.5, respectively. Combining the above results, we propose that while laccase is involved in lignin degradation, it also enhances carbon sequestration by promoting the formation of Fe-OM associations in peatland.

key words: peatland, carbon cycling, laccase, delay dynamics, Fe-bound OC

Acknowledgements: This work was granted by the National Natural Science Foundation of China (NSFC 41472316)

References


**Fig. 2.** Promoting effect of laccase on the accumulation of Fe-bound OC in peatland

**About the first author and corresponding author**

XIANG Wu, male, born in 1968 in Yiyang City, Hunan Province. Ph.D. graduated from Wuhan University. Professor of School of Earth Sciences, China University of Geosciences. His research focuses on carbon cycling and iron cycling in peatland. Email: xiangw@cug.edu.cn; phone:027-67883001,13871276255